

Patent
10/714,070

LISTING OF CLAIMS:

1. (Previously Presented) A catheter system to change the temperature of blood by heat transfer to or from a circulating working fluid, comprising:
an inlet lumen to introduce a circulating working fluid; and
at least one outlet lumen to extract a circulating working fluid, the outlet lumen having a structure disposed within the outlet lumen to maintain its shape, a shape that induces mixing in blood flowing past the outlet lumen or in the working fluid,
wherein the outlet lumen and the inlet lumen are configured such that blood flows between the outlet lumen and the inlet lumen.
2. (Original) The catheter system of claim 1, wherein the inlet lumen and the outlet lumen are made of a flexible material.
3. (Original) The catheter system of claim 2, wherein the flexible material is a material capable of undergoing inflation.
4. (Canceled)
5. (Original) The catheter system of claim 1, wherein the working fluid is saline.
6. (Original) The catheter system of claim 1, further comprising a working fluid supply including a pump, and wherein the pump circulates the working fluid.

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7. (Previously Presented) A catheter system to rewarm a patient, comprising:
a working fluid supply configured to circulate a working fluid, wherein the working fluid supply is configured to produce a working fluid at a temperature of greater than about 37°C;
an inlet lumen to introduce the circulating working fluid; and
at least one outlet lumen to extract a circulating working fluid, the outlet lumen having a structure disposed within the outlet lumen to maintain its shape, a shape that induces mixing in blood flowing past the outlet lumen or in the working fluid,
wherein the outlet lumen and the inlet lumen are configured such that blood flows between the outlet lumen and the inlet lumen.

8. (Previously Presented) A catheter method of inducing a therapeutic state of hypothermia in a patient comprising:
inserting an inflatable heat transfer element, formed by at least an inlet lumen and a single outlet lumen, into an artery or vein, the outlet lumen having a structure disposed within the outlet lumen to maintain its shape;
inflating the inflatable heat transfer element by delivering a working fluid to the inflatable heat transfer element, the temperature of the working fluid lower than that of the blood; and
passing the working fluid through a mixing inducing path formed by the outlet lumen, wherein an open path between the inlet lumen and the outlet lumen allows blood flow therethrough, thereby enhancing heat transfer between the working fluid and the blood,
wherein the outlet lumen and the inlet lumen are configured such that blood flows between the outlet lumen and the inlet lumen.

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9. (Previously Presented) A method for warming a body of a patient, comprising:

introducing a catheter having an inflatable heat transfer element, formed by at least an inlet lumen and a single outlet lumen, the outlet lumen having a mixing inducing shape and a structure within the outlet lumen to maintain its shape, into a blood vessel;
circulating a working fluid through the heat transfer element, wherein the working fluid is removed from the heat transfer element by passing through the outlet lumen, the working fluid having a temperature greater than the temperature of the blood vessel; and
such that heat is added to the blood to warm the body,
wherein the outlet lumen and the inlet lumen are configured such that blood flows between the outlet lumen and the inlet lumen.

10-13. (Canceled)

14. (Previously Presented) The catheter system of claim 1, wherein the structure comprises a wire.

15. (Previously Presented) The catheter system of claim 1, wherein the outlet lumen is made of a flexible material.

16. (Currently Amended) The catheter system of claim ~~[[1]]~~ 2, wherein the flexible material is rubber.

17. (Currently Amended) The catheter system of claim ~~[[1]]~~ 2, wherein the flexible material is capable of undergoing inflation.

18. (Currently Amended) The catheter system of claim ~~[[1]]~~ 17, wherein the structure causes the outlet lumen to maintain its approximate uninflated position.

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19. (Canceled)
20. (Previously Presented) The catheter system of claim 7, wherein the structure comprises a wire.
21. (Previously Presented) The catheter system of claim 7, wherein the outlet lumen is made of a flexible material.
22. (Currently Amended) The catheter system of claim ~~[[7]]~~ 21, wherein the flexible material is rubber.
23. (Currently Amended) The catheter system of claim ~~[[7]]~~ 21, wherein the flexible material is capable of undergoing inflation.
24. (Currently Amended) The catheter system of claim ~~[[7]]~~ 23, wherein the structure causes the outlet lumen to maintain its approximate uninflated position.
25. (Canceled)